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## DANCE MOVEMENT THERAPY AND FALLS PREVENTION

Nicola Veronese<sup>1,2</sup>, Stefania Maggi<sup>1</sup>, Patricia Schofield<sup>3</sup>, Brendon Stubbs<sup>\*3,4,5</sup>,

<sup>1</sup> National Research Council, Neuroscience Institute, Aging Branch, Padova, Italy.

<sup>2</sup> Institute for clinical Research and Education in Medicine (IREM), Padova, Italy.

<sup>3</sup> Faculty of Health, Social Care and Education, Anglia Ruskin University, Chelmsford, United Kingdom.

<sup>4</sup> South London and Maudsley NHS Foundation Trust, Denmark Hill, London SE5 8AZ, United Kingdom.

<sup>5</sup> Institute of Psychiatry, Psychology and Neuroscience, King's College London, De Crespigny Park, London SE5 8 AF, United Kingdom.

**Corresponding Author:**

Brendon Stubbs, Head, Physiotherapy Department, South London and Maudsley NHS Foundation Trust, Denmark Hill, London, United Kingdom. Tel: 00442083003100, fax 00442032282702 email: brendon.stubbs@kcl.ac.uk

## Highlights

- Dance is a popular form of physical activity with multiple health benefits.
- We conducted a systematic review of randomized controlled trials considering the benefits of dance on falls and fear of falling in older adults.
- There was inconsistent or no evidence to support the benefits of exercise on falls.
- There was some indication that dance may reduce fear of falling.
- The paucity of randomized controlled trials, heterogeneity of samples, interventions and lack of long-term follow-up preclude any firm conclusions.

## ABSTRACT

Falls are a leading cause of morbidity, healthcare use and mortality. Dance is a popular form of physical activity among older people and previous research has suggested that it may improve various health outcomes in this population, including balance, gait and muscle performance. A systematic review of the potential benefits of dance on falls and fear of falling is lacking. Thus, we conducted a systematic review considering all randomized controls trials (RCTs) investigating if dance can reduce falls and improve fear of falling in older adults. Major databases were searched from inception until 1 March 2017 and a total of 10 RCTs were identified, which included a total of 680 people (n=356 dance, n=324 control). Overall, the mean age of the samples was 69.4 years, and 75.2% were female. Across four RCTs, dance therapy reduced falls versus usual care in only one study. Dance therapy improved fear of falling in two out of three included RCTs. There were no serious adverse events reported in the RCTs. In summary, we found a paucity of studies investigating the effect of dance on falls and fear of falling and the evidence base is preliminary and equivocal. Given the heterogeneity of the included samples and interventions, in addition to the short-term follow-up, no firm conclusions can be drawn. However, dance appears to be safe and, given its popularity and demonstrated benefits on other health/wellbeing outcomes in older adults, it is important that future research considers its potential benefits on falls/fear of falling in older age.

**Keywords:** dancing; falls; older people; fear of falling; systematic review.

## INTRODUCTION

A fall is defined as an event which results in a person coming to rest inadvertently on the ground or floor or other lower level [1]. It is estimated that about one third of people aging more than 65 years falls every year and that the incidence of falls linearly increases with age.[2] However, many falls go unreported and retrospective recall of falls are inaccurate and the incidence and prevalence of falls are underestimated in the elderly. [2] Falls are associated with a range of deleterious outcomes including increased morbidity, fractures, hospitalization, and elevated risk of early mortality.[3] Moreover, the economic costs associated with falls are profound.[4]

Perhaps unsurprisingly, strategies to prevent falls are among the most important public health issues in geriatric medicine.[5] The current evidence suggests that exercise based and tailored interventions are the most effective interventions to reduce falls among older people. [5] A recent overview of all systematic reviews of meta-analyses of randomized control trials of falls prevention interventions, demonstrated that as a single intervention, exercise had the most consistent evidence to prevent falls in community dwelling older people.[6] Specifically, the authors found that there is consistent evidence that exercise reduces falls (including the rate, risk, and odds of falling), with 13/14 pooled analyses (93%) from 7 meta-analyses demonstrating a significant reduction and effect sizes ranged from 0.87 (relative risk 95% confidence interval=0.81, 0.94; number of studies=18; number of participants=3,568) to 0.39 (rate ratio 95% confidence interval=0.23, 0.66; number of meta-analyses=6).

Dance is rapidly gaining popularity among older individuals since it is enjoyable and may offer multi-dimensional benefits. Specifically, dance may have a beneficial effects on cardiovascular parameters [7, 8], balance disturbances in patients with Parkinson [9], symptoms associated with schizophrenia [10] or depression.[11] Some observational studies showed that dancing could reduce the rate of falls in elderly people.[12, 13]. In a systematic review published two years ago, the authors reported that dancing seems to have positive effects on balance, gait and dynamic mobility, strength and flexibility and all these factors are closely related with falls in the elderly.[14] Despite the promising findings from the important review,

falls were not considered as outcome. Moreover, fear of falling, one of the most important predictors for falling in the elderly, was also not included. [15]

Given this background, we conducted a systematic review to investigate if dancing is more effective than usual care in preventing falling and improving fear of falling through a systematic revision of the randomized controlled trials (RCTs) available.

## **METHODS**

This systematic review adhered to the PRISMA[16] statements and followed a structured, but unpublished protocol.

### ***Data sources and literature search strategy***

The two authors independently conducted a literature search using PubMed, EMBASE, SCOPUS, Cochrane Central Register of Controlled Trials and Clinicaltrials.gov without language restriction, from database inception until 01<sup>st</sup> March 2017 for randomized controlled trials (RCTs) investigating the effect of dancing on falls and fear of falling assessed through validated scales.

In PubMed, the following search strategy was used: “(Dance or dance movement or dance therapy or dancing) and (falls or fall or fall prevention)”. An identical search was conducted in the other databases. Conference abstracts and reference lists of included articles were hand-searched to identify and potential additional relevant articles. Any inconsistencies were resolved by consensus.

### ***Study selection***

Inclusion criteria for this meta-analysis were: i) RCTs; ii) investigated the effect of a dancing program; iii) included data regarding falls or fear of falls using validated scales (such as the Falls Efficacy Scale-International, FES-I).[17] No language restriction was placed on the included studies.

Studies were excluded if: i) did not include humans; ii) did not include a control group; iii) did not use validated scales for assessing fear of falls; iv) did not report data at follow-up evaluation regarding falls/fear of falling.

***Data extraction***

One author (NV) extracted key data from the included articles in a standardized Excel sheet and a second one (BS) checked the extracted data.

For each article, we extracted data about authors, year of publication, country, main condition of interest, setting, type and description of dancing program, follow-up duration (in weeks), and how falls were ascertained and which scales for assessing fear of falling were used and mean age and percentage of females (by treatment type: ALC or control group). Finally, we extracted data regarding the adverse events reported in each study.

***Outcomes***

The primary outcome was the incidence of falls during follow-up period in both groups. Secondary outcome was the change (between follow-up and baseline) in both groups regarding scales assessing concern of falling.

***Data synthesis***

Due to the limited number of studies for each outcome included and the high heterogeneity in both exposure (type of dancing) and outcomes (falls/fear of falls) we summarized the findings of the RCTs as descriptive results.

**RESULTS*****Search results***

Altogether, the searches yielded 272 non-duplicated articles. After excluding 262 articles based on title/abstract review, 10 articles were retrieved for full text review and six were included in the qualitative synthesis [18-23](**Figure 1**).

***Study and patient characteristics***

Full descriptive details of the included studies are reported in **Tables 1 and 2**. The six RCTs together included a total of 680 participants (356 randomized to dancing and 324 to control group). The mean age across the entire sample was  $69.4 \pm 5.3$  years ( $69.6 \pm 5.1$  in the dancing vs.  $69.2 \pm 5.5$  in the control group). About three quarters of the participants were women (75.2 in the dancing vs. 78.3% in the control group) (**Table 2**).

As shown in **Table 1**, two RCTs were conducted in Europe, one in Asia, one in South and one in North America, and finally one in Oceania. Two RCTs were conducted among sedentary older people, two among patients affected by Parkinson's disease and the other two in the general population. Four RCTs were conducted among community-dwellers. The median follow-up period was 14 (range: 10-48) weeks (**Table 1**).

The type of intervention is extensively reported in **Table 1**, differing study by study in terms of frequency (from one to three times weekly) and type of dancing.

Finally, three RCTs considered falls as outcome (mainly with self-reported information integrated with medical records) and two RCTs used scales regarding concern about falling to determine the transfer effects of training to activities of daily living as outcome (using FEI). One study reported information both regarding falls and scales for assessing concern of falling (**Table 1**).

### ***Effect of dancing on falls and fear of falling***

**Table 2** reports the main findings of the studies included in our systematic review.

Taking fall incidence as outcome, one study [18] reported a significantly lower incidence of falls in dancing group compared to control group, whilst the other three RCTs [19-21] reported a similar incidence rate between dancing and control groups (**Table 2**).

On the contrary, dancing was able to improve fear of falling compared to control group in two RCTs [19, 23], but no in another one [22] (**Table 2**).

Finally, no serious adverse events (e.g. fracture, death, hospitalization) were reported in three RCTs [20, 21, 23] showing this information.



## DISCUSSION

To the best of our knowledge, the current systematic review is the first to focus on the potential benefits for dance on falls and fear of falling in older adults. Across four studies, it transpires that dance may not be more effective than control conditions in reducing the incidence of falls. However, there was some preliminary evidence that dance therapy may improve fear of falling in older adults, with two out of three studies demonstrating a significant improvement versus control conditions. Nonetheless, dance therapy appears safe and there was no noted increase in serious or untoward incidents from the intervention.

Previous research has established that as a single intervention, exercise, particularly that which challenges one's balance and focusses on increasing muscle strength, is effective to reduce falls. [24] Moreover, there is more consistent evidence to support the use of exercise as single intervention than others such as vitamin D supplementation, home/ environmental adaptations or medication review.[6] One would have anticipated that the growing evidence base to support the health benefits of dance [25], including improved balance, gait and muscle strength [26], coupled together with dance's popularity would have served as a good platform as a falls prevention intervention. However, within our review, we only found four relevant RCTs considering falls and three considering fear of falling. Whilst it appears that dance is safe for older adults, the apparent lack of an effect in preventing falls (one out of four RCTs demonstrating a significant reduction versus control conditions) is far from conclusive. In particular, the sample sizes of the included studies (only one with more than 100 participants) were notably small and the frequency, intensity and duration of dance interventions were heterogeneous. Moreover, the relatively short duration of follow up (mean =14 weeks) is insufficient to determine if there were any long term changes in falls. Future, large scale randomized control trials are required that investigate the influence of dance over a longer term (e.g. > 6 months) of at least twice a week. Such interventions should also measure falls prospectively over 12 months in order to give an accurate reflection of the influence of the intervention on this outcome.

Within our review, we found some evidence to suggest that dance may improve fear of falling, with two out of three studies [19, 23] demonstrating that dance was more effective than control conditions. This is perhaps not surprising, given that exercise has established benefits on reducing fear of falling and its associated constructs in older adults.[27] However, due to the paucity of studies and relatively short follow up, the results on the potential benefit of dance therapy on fear of falling are far from conclusive and more high quality, large scale randomized control trials are required.

There are a number of potential hypotheses how and why dance may improve falls and fear of falling. The most obvious factor is the benefits of dance on balance, gait and muscle strength. [28] Deficiencies or suboptimal performance in each of these important factors are established risk factors for falls [29] and improvements in each of these may account for a reduction in falls. Such improvements may also improve balance confidence in older adults [30], which may therefore account for the improvements in fear of falling reported in the included studies.

Whilst our review is novel in its focus on falls and fear of falling, some limitations should be noted. The main is that the RCTs included are small in size and that the follow-up duration is probably too short to verify any beneficial intervention on falls. Second, the type of dancing was different across the RCTs adding another potential source of heterogeneity. Third, due to the limited number of studies for each outcome, we were not able to do a meta-analysis of these findings. Finally, all the studies were made among older people (mean age  $\geq 60$  years). If dance could be useful in other settings/medical conditions is not known, but of importance.

In conclusion, we identified a relative paucity of RCTs investigating the potential role of dance on falls and fear of falling. The preliminary literature suggests that dance therapy does not appear to reduce falls per se, but may improve fear of falling. However, the relative paucity of studies, heterogeneity in terms of

participants, interventions and short follow up preclude any definitive conclusions and adds to the need for future large scale RCTs.

**Contributors**

All authors contributed equally to the preparation of this review.

**Conflict of interest**

The authors declare that they have no conflict of interest.

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**Provenance and peer review**

This article has undergone peer review.

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Figure 1. PRISMA flow-chart.

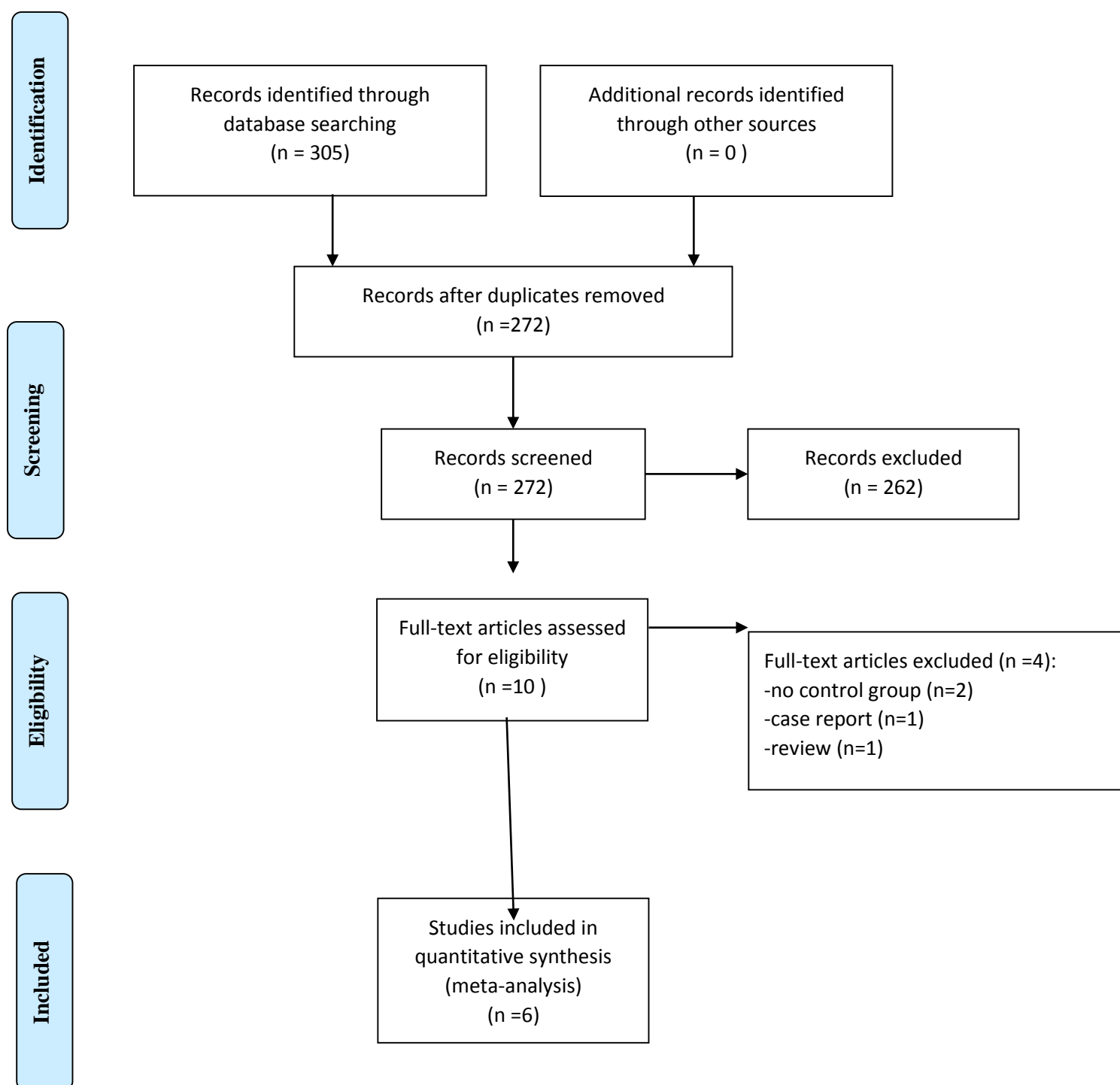


Table 1. Descriptive findings of the randomized controlled trials included.

Author (year)	Country	Main condition	Setting	Type of dancing	Description of dancing	Falls ascertainment	Fear of falling scales	Follow-up (weeks)
da Silva Borges, 2014	Brazil	Sedentary	Nursing home	Ballroom dancing	Three sessions each week of 50 minutes on alternate days over a 12-week period. The dances included the foxtrot, waltz, rumba, swing, samba and bolero.	Interview confirmed with medical records six months before	NA	12
Ventura, 2016	United States	Parkinson's disease	Community	Dance for Parkinson's	The duration of each class was 1.25 h once per week following the 3-part format	NA	FEI (16 items)	10
Pichierri, 2012	Switzerland	None	Community	Dance video game	A progressive video game dancing program for 10–15 minutes throughout the study	NA	FEI (16 items)	12
Volpe, 2013	Italy	Parkinson's disease	Community	Irish dancing	90 minute set dancing class including a preliminary warm up consisting of range of movement, balance and postural exercises	Self-reported	NA	24
Merom, 2016	Australia	None	Retirement villages	Social dancing	Dance classes were offered for one hour, twice a week, for a total of 80 h over 12 mo (allowing for short breaks).	Self-reported (through calendars)	NA	48
Wu, 2016	Taiwan	Sedentary	Community	Low-impact dancing	The movements in low-impact dance for the upper limbs were stretch, circle, shrug, abduction, adduction, and circumduction. Movements for the lower limbs were side-stepping, forward and backward walking, circling, lifting the legs, tiptoeing with the foot to the front, side, and rear, and heel raises.	Weekly self-reported	Modified Falls Efficacy Scale	16

Table 2. Main findings of the trials included.

Author (year)	Dancing group				Control group				Main findings regarding falls	Adverse events (other than falls)
	N	Age	SD	Females	N	Age	SD	Females		
da Silva Borges, 2014	30	68	8.3	NA	29	67	7.7	NA	Fewer falls in the dancing group compared to the control group ( $p < 0.0001$ ).	Not reported
Ventura, 2016	8	71.8	3.6	8	5	70.4	5.5	5	Significant reduction in FEI in dancing group compared to control group ( $p < 0.0001$ )	None in both groups
Pichierri, 2012	11	86.9	5.1	8	11	85.6	4.2	10	No significant differences between groups in FEI at follow-up	Not reported
Volpe, 2013	12	61.5	4.5	5	12	65	5.3	6	No differences in falls incidence between groups	No hospitalization in both groups
Merom, 2016	279	>80 years : 43%	NA	231	251	>80 years: 35%	NA	217	No significant difference in fall rates between the control group (0.80 per person-year) and the dance group (1.03 per person-year).	None in both groups
Wu, 2016	16	60	4	16	16	58	5	16	Significant reduction in FEI in dancing group compared to control group ( $p < 0.0001$ ); the number of falls did not significantly differ between the two groups	Not reported